WATER QUALITY AND USE

Water quality problems are prevalent for several streams within the basin. Agriculture, coal strip mines and municipal sewage discharges are the major sources of water quality problems.

Land use is predominantly agricultural (approximately 78% row crop, pasture and hayfield, 20% forest and 0.7% mined lands; Table 7). The Natural Resources Conservation Service estimates sheet erosion at 2.5-5 tons/acre/year and gully erosion at 0-0.15 tons/acre/year (MDNR 1992a). Problems associated with agricultural runoff include turbidity, sedimentation, low dissolved oxygen (DO), high nitrogen and phosphorous concentrations, high ammonia and high fecal coliform counts. Livestock grazing in the watershed and discharges from unregulated or faulty animal waste facilities (lagoons or pits serving confined lots) increase nutrification, ammonia, nitrogen, coliform and biological oxygen demand (BOD). Channelization of the Marais des Cygnes River and Miami Creek and headcutting of tributary streams increase erosion and sedimentation to streams.

Many streams are polluted by drainage from coal mines, and mining continues to occur at several locations. Mine drainage increases erosion, sedimentation, conductivity, acidity and sulfate, iron and manganese concentrations; and it decreases pH. Strip mine reclamation by MDNR has improved water quality at several locations in the basin (Table 20).

Municipal sewage discharges impact several streams. Elevated ammonia, fecal coliform and nutrient levels, excess aquatic plant growth, low DO, high BOD and other problems are associated with these discharges.

Water quality information for some streams within the basin has been reported by Ryck (1974b) for 1967-1971, Kersh (1977) for 1973-1975, Duchrow (1984) for 1975-1976, MDNR (1984, 1986b, 1989b, 1992a, 1993) and USGS (1979-1992). Additional sources include Department Stream Pollution Surveys and Annual Water Pollution Investigations, and other water pollution reports. Department staff in Sedalia recorded water quality information at selected sample sites from 1990-1991 (Table 21). At this writing, preliminary information on fish, water chemistry, invertebrates, and physical characteristics has been collected by United States Geological Survey (USGS) for the National Water Quality Assessment Program (Jim Petersen, USGS Little Rock, AR, personal communication).

Pollution may prevent some streams within the basin from meeting their beneficial use standards. Aquatic life and livestock watering will not be possible for streams affected by acid mine drainage until adequate land reclamation occurs. Point source discharges will reduce aquatic life in some downstream areas (MDNR 1984). Beneficial water uses for several streams within the basin are listed in Table 22.

Sixteen documented pollution incidents have resulted in the loss of more than 37,000 fish in 13 streams within the basin (Table 23). Natural causes, municipal sewage discharges, acid mine drainage, cattle manure and unknown sources are responsible for these fish kills. The largest fish kill on record was in 1984 on a 26 mile section of the Osage Arm of Truman Lake when at least 35,000 fish died from a combination of bacterial and fungal infections.

In order to assess the degree and nature of contamination of Missouri waters, the Department began a fish tissue contaminant monitoring program in 1984. Between 1987 and 1991, Department personnel collected paddlefish, carp, blue catfish or channel catfish at several locations within the Basin for analysis. Level II health advisories (limited consumption for chlordane) were issued in 1990 and 1991 for channel catfish in the Osage River in Bates County, and in 1990 for carp in the Osage arm of Truman Lake (Missouri Dept. Health news releases 1990, 1991). At this writing, there are no contaminant warnings for fish within the basin and no routine contaminant sampling is being conducted.

The following is a summary of water quality information reported on selected streams within the basin. It is not a complete listing of all areas affected by pollutants, but includes those documented by the previously mentioned sources. Duchrow's (1984) pollution classification for streams within the basin is presented in Table 24, and chemical and water quality data collected by Department personnel are summarized in Table 21. Tables 25-27 contain additional information on documented point and non-point pollution sources. Locations reported in Tables 20-21 and 25-27 are marked on Figures 8-13. Where appropriate, water quality data are compared to standards for protection of designated beneficial uses reported in MDNR (1989a) and Van der Leeden (1990).

Based on Department of Natural Resources data, water quality from the Weaubleau subbasin is good (MDNR 1986b, 1989b). Only two documented problems involving excess nutrients and a discharge of cattle manure into tributaries of Weaubleau Creek caused temporary water quality problems (Table 27; MDNR 1986b, 1989b). Sampling conducted by Department personnel showed all parameters within normal ranges for their designated beneficial uses (Table 21).

The Monegaw subbasin suffers from water quality problems attributed to contamination from abandoned coal mines, municipal sewage discharges and agriculture.

Monegaw Creek has a history of water quality problems associated with abandoned and poorly reclaimed coal-mined lands which dates back to 1951 (Duchrow 1984). These problems include erosion, acid mine drainage, sedimentation and high sulfate concentrations (Tables 20 and 25; Ryck 1974b, Kersch 1977, Duchrow 1984, MDNR 1986b, 1989b, 1992a). Ricky Creek, a tributary to Monegaw Creek, also has been affected by runoff from abandoned coal mines. Some reclamation work has been completed on these streams (Table 20). As of 1991, Monegaw and Ricky creeks were not acidified, but were mineralized by sulfate leaching from spoils or coal waste areas (MDNR 1989b, 1992a). Monegaw Creek also contains substantial amounts of coal wastes deposited before any reclamation was initiated (MDNR 1992a). The headwaters of

Monegaw Creek also receive sewage effluent from the Appleton City sewage treatment plant (Table 27).

Other streams within the subbasin have been impacted by pollution. Acid mine drainage has affected tributaries to Salt, Turkey and Gallinipper creeks (Table 25). Municipal sewage discharges from Osceola and Lowry City have polluted the Osage River and a tributary to Gallinipper Creek, and agricultural sources have impacted a few additional streams (Table 27). Localized water quality problems (high chemical oxygen demand {COD} and elevated fecal coliform bacteria levels) in the Osage River attributed to discharges of inadequately treated sewage from the Osceola sewage treatment plant have been reported (Table 27; Kersch 1977).

Routine water quality sampling occurs at the USGS gaging station (No. 06918070) on the Osage River above Schell City (period of record: 1979 - present). Occasional low DO and elevated fecal coliform bacteria levels have been reported (USGS 1979-1992).

Department water quality sampling indicated low DO and elevated ammonia levels in Little Monegaw Creek, elevated ammonia in Panther Branch, and relatively high conductivity at the Ricky Creek and Ladies Branch sampling sites. Other values were within normal ranges for their designated uses (Table 21).

Clear Creek subbasin suffers from water quality problems associated with agriculture, coal mining and municipal sewage effluent. Walnut Creek has been polluted by sewage discharges from the El Dorado Springs sewage treatment plant (Table 27; Ryck 1974b, Duchrow 1984, MDNR 1986b). Treated sewage effluent also enters streams from Camp Clark Military Reservation and several smaller facilities (Table 27; Duchrow 1984). Robinson Branch is most severely affected by contamination from strip-mined lands, but one area reclaimed in 1987 shows improved water quality (Table 20; Kersh 1977, MDNR 1986b).

The largest hog operation in Missouri is located within this subbasin. Murphy Farms is located along Clear Creek (SE1/4 S33 and S34, T34N, R30W in Vernon County, and NW1/4 S3 and NE1/4 S4, T33N, R30W in Barton County). A discharge of hog lagoon contents into Clear Creek from Murphy Farms was reported in May 1992 (Table 27; Department Fisheries District files). The lagoon discharged for about 12 hours before a missing cap was placed on a recycling tube, stopping the discharge. No fish kill occurred.

Water quality sampling indicated elevated ammonia levels at the Clear Creek and McCarty Creek sampling sites. Other values fell within normal ranges for their designated uses (Table 21).

Water quality sampling within the Marais des Cygnes River subbasin has revealed many pollution problems associated with contamination from strip-mined lands, municipal sewage effluent, agriculture, and non-point and point source pollution entering from Kansas and other sources. During low flows, the Marais des Cygnes River has exceeded secondary drinking water supply standards for sulfates (MDNR 1986b).

Contamination from abandoned and reclaimed coal mines is a major problem for several streams in this subbasin (Tables 20, 25 and 25; Ryck 1974b, Kersh 1977, Duchrow 1984, MDNR 1986b, 1989b, 1992a). Erosion, sedimentation, acid mine drainage, high sulfate concentrations and iron deposits have seriously degraded some streams. Walnut Creek appears to be the most impacted. Mulberry Creek, Park Branch, New Home Creek, Miami Creek, the Marais des Cygnes River and other tributaries also are affected. A reclaimed area (1986) within the Walnut Creek watershed continued to be a source of acid mine drainage and iron deposits for that stream after reclamation (Table 20). At present, nine miles of Mulberry Creek and four miles of Walnut Creek are mineralized by coal mine drainage, but no streams are believed to be acidified (MDNR 1992a).

Discharges from municipal sewage treatment plants impact some streams and were responsible for four fish kills within the subbasin from 1977 to 1989 (Tables 23 and 27; Kersh 1977, Duchrow 1984). Discharges from the Butler sewage treatment plant flow into Mound Branch, the Rich Hill facility discharges into Park Branch, and the Drexel North and South plants discharge into Sugar Creek (Table 27).

Documented water quality problems associated with agriculture include elevated nutrient levels, decreased water clarity and manure in streams (Table 27; Kersh 1977, Duchrow 1984). Department water quality sampling indicated elevated ammonia levels for several streams, and a few low DO measurements during August 1991. Sampling at the Root Branch site (29-Aug-1991) showed high pH, low DO and elevated ammonia levels. Other values fell within normal ranges for their designated uses (Table 21).

Sources of water quality problems in the Marmaton subbasin include agriculture, contamination from coal mines, municipal sewage discharges, pollution entering from Kansas and other sources. Duchrow (1984) reported that the Marmaton River was highly mineralized, characterized by high specific conductance values and sulfate concentrations. The Marmaton River has exceeded total sulfate concentration standards for public drinking water supplies, irrigation and livestock watering (Kersch 1977). Poor water quality within the Marmaton subbasin contributes to aquatic degradation (Duchrow 1984).

Problems associated with abandoned and reclaimed coal mines have degraded a few streams (Tables 20, 24 and 25; Kersh 1977, Duchrow 1984, MDNR 1989b). Erosion, sedimentation and acid mine drainage have most seriously affected Willow Branch. The Willow Branch watershed drains a reclaimed area (1986) that suffered from acid mine drainage but now has only mineralized water (Table 20; MDNR 1992a). Other affected streams include the Marmaton River, Little Osage River and Grassy Run (Table 25).

Municipal pollution sources have impacted three streams (Tables 24 and 27; Duchrow 1984). Nevada's sewage treatment plant discharges into White Branch, the Marmaton receives discharges from the Fort Scott, Kansas sewage treatment plant and Douglas Branch has received municipal refuse (Tables 24 and 27; Duchrow 1984, 1991, MDNR 1986b).

Erosion and sedimentation from agricultural lands have caused water quality problems in the subbasin (Duchrow 1984). Industrial dumping and discharges, runoff from a landfill and low summer DO levels also have been reported for the Marmaton and Little Osage rivers (Table 27; Ryck 1974b, Kersh 1977).

Department water quality sampling indicated some elevated ammonia levels and high conductivity values for the Marmaton and Little Osage rivers. Other values fell within normal ranges for their designated uses (Table 21).

The Dry Wood subbasin suffers from chronic water quality problems. Past, present and reclaimed coal-mined lands, municipal sewage discharges, agriculture and other sources are responsible.

Several streams have had or currently have severe pollution problems associated with coal mines (Tables 20 and 25; Kersh 1977, Duchrow 1984, MDNR 1989b, 1992a). These problems include erosion, sedimentation, acid drainage, iron and manganese deposits, and elevated sulfate concentrations. The most severe degradation, occurring since 1949, is within Dry Wood Creek and some of its tributaries (Duchrow 1984). Currently, about 60 miles of Dry Wood Creek, West Fork of Dry Wood Creek, Moore's Branch and other tributaries are mineralized by drainage from these lands (MDNR 1992a). Known acidified streams include four miles of Fleck Creek and tributaries, located within and just south of Prairie State Park (MDNR 1992a). Duchrow (1984) reported that three known fish kills caused by acid water occurred within the Dry wood Creek watershed.

Municipal discharges further degrade streams within the subbasin. The Nevada sewage treatment plant discharges into Little Dry Wood Creek have caused two documented fish kills (Table 23). Effluent from the city of Liberal enters Bitter Creek (Table 27).

Additional pollution includes erosion, sedimentation, cattle manure in streams and other problems associated with agriculture (Table 27; Duchrow 1984, MDNR 1989b). Occasional oil spills from the oil and gas industry have been reported in Moore's Branch and other small streams (Table 26; Duchrow 1984, MDNR 1986b).

Department water quality sampling showed high conductivity values for Dry Wood Creek, Second Nicolson Creek, McKill Creek and West Fork of Dry Wood Creek. An elevated ammonia level was also recorded in Dry Wood Creek. Other values fell within normal ranges for their designated uses (Table 21).

Several major surface withdrawals occur within the basin. A major water user is defined as anyone capable of withdrawing or diverting 100,000 gallons or more per day. Even though registration is required, major water user information is probably incomplete since there are no fines for not reporting water use (Jeanette Barnett, MDNR, Rolla, MO, personal communication).

Six public water supply surface withdrawals currently occur within the basin (Table 28). The city of Butler is the only major user. Butler withdraws water from Miami Creek, and has two auxiliary supplies on the Marais des Cygnes River and Butler City Lake.

Ten major surface withdrawals for irrigation are listed in Table 28. In addition, the COE uses approximately 7,439,330 acre feet of water per year for generating electricity at the Harry S. Truman Dam (MDNR 1992b). Two major water users for fish and wildlife management purposes include the Four Rivers Conservation Area which withdraws 221 acre feet/year from the Marmaton River, and the Schell-Osage Conservation Area which uses 1,228 acre feet/year from Schell and Atkinson lakes (MDNR 1992b). Water withdrawals may increase with future wetland development. No major water withdrawals for industry presently occur within the basin (MDNR 1992b). The COE in Kansas is planning to sell water from Pomona, Melvern, and Hillsdale reservoirs to various municipalities. The extent of these proposed withdrawals is unknown (Jim Triplett, Pittsburg State University, Pittsburg KS, personal communication).

Municipal sewage effluent is the main point pollution source within the basin. Several municipalities discharge wastewater into streams (Tables 23, 24 and 27). The three largest include Nevada, El Dorado Springs and Butler. El Dorado Springs affects the lower two miles of Walnut Creek, and Nevada's discharge has some effect on the lower 1.5 miles of Little Dry Wood Creek and the immediate downstream section of the Marmaton River. In both cases, elevated ammonia levels during dry weather is the main concern (MDNR 1992a). Both facilities will probably require advanced waste treatment in order to meet instream standards for ammonia (MDNR 1992a). Butler discharges into Mound Branch and probably experiences the same problems with ammonia levels.

Rich Hill, Osceola and Appleton City are the next largest municipal point discharges. Rich Hill flows into Slaughter Branch and Appleton City into Monegaw Creek. Rich Hill and Osceola have had chronic problems meeting effluent limits at their wastewater treatment plants. Elevated levels of fecal coliform bacteria in Truman Lake near Osceola has been a problem (MDNR 1984, 1992a, 1993).

Smaller wastewater discharges into streams within the basin include Lowry City (Gallinipper Creek), Liberal (Bitter Creek), Drexel (Sugar Creek) and Sheldon (Little Clear Creek). Other domestic wastewater discharges in the basin generally affect less than one half mile of their receiving streams (Duchrow 1984, MDNR 1984, 1992a).

There also are a few small oil and gas recovery facilities in the basin. Oil extraction is often by pressurized injection of salt water, and overflows of petroleum and salt water from pits have occasionally affected Moore's Branch and other small streams (Table 26; MDNR 1992a).

WATER QUALITY PROBLEMS

The main sources of non-point water quality problems within the basin are agricultural lands and coal-mined areas (Tables 20, 23, 24, 25, 26 and 27).

Many streams within the basin are impacted by drainage from active, abandoned and reclaimed coal-mined lands. The Dry Wood subbasin is the most impacted (primarily Dry Wood Creek and its tributaries). This includes about four miles of acidified streams, and 60 miles mineralized by the leaching of sulfate and chloride (MDNR 1992a).

As of 1991, Monegaw and Ricky creeks were not acidified, but were mineralized by sulfate leaching from spoils or coal waste areas. Monegaw Creek also contains substantial deposits of coal waste on the stream bottom deposited prior to reclamation (MDNR 1992a). Two other streams mineralized by coal mine drainage are Walnut Creek and tributaries (15 miles), and Mulberry Creek (9 miles). In addition, there are some small mineralized streams draining into a wetland area adjoining the Little Osage River just north of Arthur, Missouri (MDNR 1992a).

Since all recently mined land must be immediately reclaimed by the mining company, water quality within the basin should continue to improve. The Mulberry Creek watershed is a good example. Mulberry Creek flows through a large, recently mined and reclaimed area. The water is now mineralized but not acid. Therefore, present and future coal mining within the basin will continue to cause mineralization of receiving streams, but may not cause acidity problems (MDNR 1992a).

Major sources of non-point pollution to Truman Lake, such as nitrogen, phosphorous, sediment and biological oxygen demand, come mainly via inflows from the Osage and South Grand rivers rather than the smaller tributaries within the basin. Sampling over several years by the COE has shown poorer dissolved oxygen in the Osage and South Grand arms of the reservoir than in the Sac and Pomme de Terre arms, indicating greater amounts of BOD are entering form the former two streams (MDNR 1992a).

Sampling of Truman Lake in several locations in 1988 by the COE detected low levels (0.2-0.7 ppb) of the common agricultural herbicide atrazine at several locations in the lake. These levels are below the drinking water standard for atrazine (3.0 ppb). However, atrazine levels have exceeded water quality standards in some tributary streams during some years. Farm chemicals are a potential problem that should be monitored since Truman Lake is a source of drinking water for a number of communities (MDNR 1992a). The impact of private sewage lagoons and septic systems on ground and surface water are unknown.

Table 22. Beneficial water uses of streams within the West Osage River Basin in west-central Missouri (MDNR 1984)

STREAM	COUNTY	BENEFICIAL WATER USES
Monegaw Subbasin		
Baker Branch	St. Clair	LWW,AQL
Brush Creek	St. Clair	LWW,AQL
Camp Branch	Bates	LWW,AQL
Clammer Branch	St.Clair	LWW,AQL
Gallinipper Creek	St. Clair	LWW,AQL
Little Monegaw Creek	St. Clair	LWW,AQL
Ladies Branch	Vernon	LWW,AQL
Monegaw Creek	St. Clair	LWW,AQL,WBC,LWC
Panther Creek	Bates	LWW,AQL
Reid Creek	St. Clair	LWW,AQL
Ricky Creek	St. Clair	LWW,AQL
Salt Creek	St. Clair	LWW,AQL
Trib to Salt Creek	St. Clair	LWW,AQL
Simms Creek	St. Clair	LWW,AQL
Yellow Creek	St. Clair	LWW,AQL
Trib to Yellow Creek	St. Clair	LWW,AQL
Clear Creek Subbasin		
Clear Creek	St.Clair, Vernon	LWW,AQL,WBC
Kitty Creek	St.Clair, Vernon	LWW,AQL
Little Clear Creek	St. Clair	LWW,AQL
Trib to Little Clear Creek	St.Clair	LWW,AQL
McCarty Creek	Vernon	LWW,AQL
Walnut Creek	St.Clair, Cedar	LWW,AQL
West Fork Clear Creek	Vernon	LWW,AQL
Maris des Cygnes River Subbasin		
Bones Branch	Bates	LWW,AQL
Double Branch	Bates	LWW,AQL

Table 22. Continued.

STREAM	COUNTY	BENEFICIAL WATER USERS
Knob Creek	Bates	LWW,AQL
Marais Des Cygnes River	Bates	IRR,LWW,AQL,WBC,LWC,DWS
Miami Creek	Bates	LWW,AQL
Mound Branch	Bates	LWW,AQL
Mulberry Creek	Bates	LWW,AQL
Walnut creek	Bates	LWW,AQL
<u>Weaubleau Subbasin</u>		
Bear Creek	St. Clair	LWW,AQL,WBC,LWC
Hogles Creek	Benton, Hickory, St.Clair	LWW, AQL
Little Weaubleau Creek	St. Clair, Hickory	LWW,AQL,WBC
South Fork Weaubleau Creek	St. Clair	LWW,AQL,WBC
Weaubleau Creek	St. Clair, Hickory	LWW,AQL,WBC,LWC
<u>Marmaton Subbasin</u>		
Duncan Creek	Vernon	LWW,AQL
Little Osage River	Vernon	IRR,LWW,AQL
Marmaton River	Vernon	IRR,LWW,AQL
Muddy Creek	Vernon, Bates	LWW, AQL
Old Town Branch	Vernon	LWW, AQL
Twomile Creek	Vernon	LWW, AQL
<u>Dry Wood Subbasin</u>		
Comstock Creek	Vernon, Barton	LWW,AQL
Dry Wood Creek	Vernon, Barton	LWW,AQL
East Fork Dry Wood Creek	Barton	LWW,AQL
Little Dry Wood Creek	Vernon, Barton	LWW,AQL
Landon Branch	Vernon	LWW,AQL
McKill Creek	Vernon	LWW,AQL
Moores Branch	Vernon	LWW,AQL

Table 22. Continued.

STREAM	COUNTY	BENEFICIAL WATER USERS
Pleasant Run Creek	Vernon	LWW,AQL
Second Nicolson Creek	Barton	LWW,AQL
West Branch	Barton	LWW,AQL
West Fork Dry Wood Creek	Vernon	LWW,AQL

IRR= Irrigation
LWW= Livestock and Wildlife Watering
AQL= Protection of Warm Water Aquatic Life: Warm Water Fishery
WBC= Whole Body Contact Recreation
LWC= Limited Water Contact Recreation: Boating and Canoeing
DWS= Drinking Water Supply

Table 25. Coal mined areas (not active, not reclaimed) as sources of non-point pollution within the West Osage River Basin of west-central Missouri (MDNR 1984, 1992a, 1993 Fish Kill and Water Pollution Investigations).

SOURCES	COUNTY/ SUBBASIN*	LEGAL DESCRIPTION S-T-R	RECEIVING STREAM	NON-POINT DISCHARGE **	TOTAL ACRES
HELLBENDER AREA	ST CLAIR/M&G	NW 2,39N,28W	RICKY CREEK	S04	318.0
HAWES AREA	ST CLAIR/M&G	NE NE 13+SE NE 16+ NW SE 15,38N,26W	TRIB SALT CREEK TRIB TRUMAN RES	AMD	36.0
JONES AREA	ST CLAIR/M&G	8,39N,28W	MONEGAW CREEK	AMD	150.0
CORRELL COAL AREA	BARTON/DWD	C S 28,33N,32W	TRIB TO E FORK DRY WOOD CREEK	AMD,SD	16.5
MAX ROSE AREA	BARTON/DWD	18+19+30,32N,32W	1ST NICOLSON CK E FK DRY WOOD CK	AMD	772.0
GARY PETERSON AREA	BARTON/DWD	C 6,33N,33W	TRIB TO DRY WOOD CREEK	AMD	151.0+
SWIMMING PIT AREA	BARTON/DWD	29+30,33N,33W	TRIB TO WEST ELM BRANCH	AMD,SD,E	129.0
LESTER DAVIS AREA	BARTON/DWD	20+28+29+32, 32N,33W	FLECK CREEK	AMD	888.0
PARRY AREA	BARTON/DWD	6-8,32N,33W	W ELM BRANCH 2nd NICOLSON CK	AMD	705.5
PRAIRIE STATE PARK AREA	BARTON/DWD	17-20,32N,33W	FLECK CREEK	AMD	52.0
MOORE AREA	BARTON/DWD	19+30+31,32N,33W	TRIB TO FLECK CK	AMD,SD,E	1039.0
MASSA AREA	BARTON/DWD	30+31,33N,33W	TRIB TO COW CK	AMD	46.0
ARDATH-MASSA AREA	BARTON/DWD	18+19+30,33N,33W	TRIB TO DRY WOOD CREEK	AMD	687.0
BILL'S AREA	VERNON/DWD	W SE 6,34N,33W	TRIB TO DRY WOOD CREEK	AMD,FE,MN, MW	50.0
MOSHER AREA	VERNON/DWD	28+29+32+33, 34N,32W	TRIB McKILL CK TRIB L DRY WOOD C	AMD	67.0
ADAMS AREA	VERNON/DWD	30+31,34N,33W	TRIB TO W FORK DRY WOOD CREEK	AMD,SD	40.0
MOUNDVILLE AREA	VERNON/DWD	NW 5+NE 6,34N,32W	HACKBERRY BRANCH	AMD,SD	5.5

* M&G = Monegaw & Gillinipper Creeks subbasin, DWD = Dry Wood & L Dry Wood Creeks subbasin

** AMD = acid mine drainage, SD = sediment deposition, SO4 = sulfate, E = erosion, NW - mineralized water, FE = iron, MN = manganese

Table 25. Continued.

SOURCES	COUNTY/ SUBBASIN*	LEGAL DESCRIPTION S-T-R	RECEIVING STREAM	NON-POINT DISCHARGE**	TOTAL ACRES
COMSTOCK AREA	VERNON/MLO	NW 9,35N,33W	GRASSY RUN	AMD,SD,E	3.0
DEERFIELD AREA	VERNON/MLO	SE 3,35N,33W	TRIB TO MARMATON RIVER	AMD,SD,E	12.0
COX AREA	VERNON/MLO	W 27+NE 28,38N,31W	TRIB TO WILLOW CK	AMD	171.0
LYONS AREA	VERNON/MLO	NW SW SE 34,38N, 31W	TRIB TO WILLOW CK	AMD,SD,E	11.0
MARLIN AREA	VERNON/MLO	NW SW 33,38N,31W	TRIB TO WILLOW CK	AMD,SD,E	92.0
CLUTTER GOB	VERNON/MLO	SE SE SE 32,38N,31W	TRIB TO WILLOW CK	FE	0.25
WOOFEN AREA	BATES/MDCR	SW SE 3,39N,33W NE NW 10,39N,33W	TRIB TO WALNUT CK	AMD,SD,E	3.0
WORLAND AREA	BATES/MDCR	NE SE 7,39N,33W S NW 8,39N,33W	TRIB TO MARAIS DES CYGNES RIVER	AMD	7.0
JACOBS AREA	BATES/MDCR	SW4,39N,33W	TRIB TO WALNUT CK	AMD	8.5
FRANKLIN AREA	BARTS/MDCR	SW 6+NW 7,38N,33W	WALNUT CREEK	AMD	227.5
LOST TIPPLE	BATES/MDCR	E 8+W 9+NW16 39N,33W	TRIB TO WALNUT CREEK	AMD,SD,E	73.0+
BLACK DIAMOND AREA	BATES/MDCR	NE13,39N,33W NW 18,39N,32W	TRIB WALNUT CK TRIB MDCR	AMD	15.0
LITTLE TIPPLE AREA	BATES/MDCR	NE 30,39N,33W	COTTONWOOD CK	AMD	4.5
HOEPER AREA	BATES/MDCR	4+ E 5,38N,32W	TRIB TO NEW HOME CREEK	AMD	1.0
LINKS AREA	BATES/MDCR	SW NE 5,38N,31W	TRIB TO PARK BRANCH	AMD	2.0
McCOMBS AREA	BATES/MDCR	SE NE NW 4,38N,31W	PARK BRANCK	AMD	5.0

* MLO = Marmaton & Little Osage Rivers subbasin, MDCR = Marais des Cygnes River subbasin
** AMD = acid mine drainage, SD = sediment deposition, FE = iron precipitate, E = erosion